Survey Protocol for the Endangered Quino Checkerspot Butterfly (*Euphydryas editha quino*) for the 1999 Field Season

January 25, 1999

EXECUTIVE SUMMARY

The Quino checkerspot butterfly (*Euphydryas editha quino*) (Quino) was listed as an endangered species on January 16, 1997 (62 FR 2313). This animal is protected under the provisions of the Endangered Species Act of 1973, as amended (Act).

The recommended protocol includes general habitat assessments that can be conducted throughout the year. Focused habitat assessments should be completed in areas of potential habitat delimited on the Survey Area Map. Adult Quino flight season surveys (adult surveys) should be conducted in areas where recent occurrences have been recorded or suitable habitat is present.

Recovery permits under section 10(a)(1)(A) of the Act and issued by the U. S. Fish and Wildlife Service are not required for biologists conducting general or focused habitat assessments. Permits are required to conduct adult surveys. Incidental take authorization for the Quino checkerspot butterfly should be obtained pursuant to sections 7 or 10 of the Act prior to activities that may result in take of the animal.

The following items summarize the 1999 survey protocol for the Quino:

- The protocol can be conducted within a single year.
- Focused habitat assessments can be conducted from February 1 through May 31 within the Potential Habitat Area on the Survey Area Map.
- Adult surveys should be conducted within the Adult Focused Surveys Areas on the Survey Area Map.
- Adult surveys should be conducted within the Potential Habitat Area when suitable habitat is identified.
- Adult surveys should be conducted approximately every 7 days for the duration of the flight season (generally early March to mid-May).
- Appendices include a flowchart, natural history sheet, and a Survey Area Map to assist biologists and landowners.

The 1999 survey protocol and appendices can be downloaded from the Region 1 web page at http://www.r1.fws.gov/text/species.html or can be obtained by contacting the Portland Regional Office at 503-231-2063, the Carlsbad Fish and Wildlife Office at 760-431-9440, or the Ventura Fish and Wildlife Office at 805-644-1766.

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I. INTRODUCTION

The Quino checkerspot butterfly (*Euphydryas editha quino*) (Quino) was listed as an endangered species on January 16, 1997 (62 FR 2313). This animal is protected under the provisions of the Endangered Species Act of 1973, as amended (Act). To avoid take of this federally listed species, adult Quino flight season surveys (adult surveys) must be conducted by a biologist possessing a recovery permit pursuant to section 10(a)(1)(A) of the Act (hereafter, permitted biologist).

This document provides a survey protocol to determine the presence or absence of the Quino for the 1999 field season. This survey protocol and appendices are based upon the 1998 interim guidelines, input from entomologists and biologists knowledgeable about this species, data collected during the 1998 field season, literature on Quino and other *Euphydryas editha* subspecies, and other information available to us. These data represent the best commercial and scientific information available.

We are continuing to work with entomologists, local biologists, commercial organizations, and other interested parties to collect additional laboratory and field data on the distribution, ecology, and biology of the Quino. We will review and revise this survey protocol, annually, using the latest scientific and commercial data available. This protocol should be followed for all habitat assessments and adult surveys.

II. SURVEY RECOMMENDATIONS

The survey strategy is illustrated in the flowchart attached as Appendix A. Within the historic range of Quino, we have identified areas with no potential for Quino, with potential habitat where adult surveys may be necessary of suitable habitat occurs on a site, and with Quino habitat where adult surveys should be conducted. Therefore, lands should first be assessed to determine if they fall inside or outside the Potential Habitat Area or within the Adult Focused Survey Areas on the Survey Area Map (Appendix B). If the land falls within the Adult Focused Survey Areas, adult surveys should be conducted throughout the entire flight season. If land is outside of the Potential Habitat Area, no habitat assessments or adult surveys are recommended. If land falls within the Potential Habitat Area and outside of the Adult Focused Survey Areas, the habitat suitability for Quino should be assessed by searching, identifying, and mapping habitat components (food and nectar plants, open, sparsely vegetated areas, and suitable topographic features) in the project vicinity. If suitable habitat is identified, as described below, adult surveys should be conducted throughout the entire flight season (early March to the middle of May).

We will monitor reference Quino populations in San Diego and Riverside counties to determine the beginning and end of the adult flight season for 1999. All permitted biologists will be notified within 24 hrs of the initiation of the flight season and also at its close. If drought limits

population sizes and shortens the length of the 1999 flight season, abbreviated surveys may not be considered adequate to determine absence of the Quino. Nevertheless, we will be available to work closely with project proponents to develop proposals that would avoid or minimize impacts. Because of the seasonal nature of Quino surveys and the need for immediate field mobilization, we suggest that habitat assessments and/or adult surveys be scheduled prior to the flight season.

A. Habitat Assessments

Informal or general habitat assessments can occur at any time throughout the year. These assessments may determine if a focused habitat assessment should be conducted. If the potential for Quino habitat exists within the Potential Habitat Area (see Appendix B), then focused habitat assessments are recommended. Focused habitat assessments should be initiated between February 1 and May 31, and prior to the end of the adult flight season, to maximize detection of food plants and nectar sources and minimize potential harm to larvae. Focused assessments should determine if suitable Quino habitat is present on the site by searching, identifying, recording (see Appendices C, D), and mapping, if present, habitat components (e.g., larval food plants; nectar sources; open, sparsely vegetated areas; and suitable topographic features; Appendix E). Within the assessment area, if suitable habitat components are present and when an ocular estimated average of one or more *Plantago erecta* plant(s) per square meter is identified within any 100 square meter area (i.e., 100 *Plantago erecta* plants within any 100 square meter area), adult surveys are warranted. We recommend that each biologist conducting a focused habitat assessment, survey no more than 100 acres in 8 hours (12.5 acres/hr). Biologists should photograph representative areas of suitable habitat (see Appendix C).

B. Adult Surveys

Adult surveys must be conducted by a permitted biologist throughout the entire length of the flight season for both the Potential Habitat Area, if suitable Quino habitat is identified as described above, and the Adult Focused Survey Area (Appendix B). We recommend that a written pre-survey notification be sent to the appropriate Fish and Wildlife Office. Biologists conducting adult surveys should focus on the identification of butterflies, larvae, and/or habitat components. Adult surveys should not be conducted incidentally or concurrently with other focused surveys (e.g., California gnatcatcher) and may be initiated without a prior habitat assessment.

The following should be followed for adult surveys:

1. Adult surveys should be conducted at least every 7 days from the date of flight initiation until the end of the flight season. We will determine the flight season dates from observations at the reference populations.

2. Surveys should not be conducted if weather conditions are inappropriate (e.g., rain, drizzle, wind greater than 5 mi/hr, or temperatures less than 65°F), but it should be noted if conditions preclude surveys for 7 days (e.g., 7 days of rain). Adult surveys should be conducted between 0900 hrs and 1600 hrs.

3. Adult surveys should concentrate in areas that contain larval food plants, nectar sources, and adjacent suitable topographic features (e.g., hilltops and ridgelines). Maximum survey effort should be concentrated on these specific high potential locations during the weekly surveys. The same locations should be revisited during each weekly survey, preferably by the same permitted biologist(s).

4. If a focused habitat assessment was not conducted prior to the adult surveys, then all areas containing habitat components should be mapped during the first site visit.

5. Suitable habitat should be surveyed at a relatively slow pace (i.e., approximately 1 mi/hr) with special care taken to avoid harming or harassing any Quino larvae or adults that are detected. Each biologist should not survey more than 100 acres in 8 hours (12.5 acres/hr). Biologists should also search topographic features for brief periods (e.g., 5-10 minutes) for Quino, and should revisit these sites during the survey.

6. Biologists should record all butterfly species detected while conducting surveys. Field forms (see Appendix D) should indicate the number of each species observed.

7. If the permitted biologist determines that Quino are present at a site, the appropriate Fish and Wildlife Office must be notified within one (1) working day by telephone and/or fax and within two (2) working days by letter. The notification should include a 7.5' U.S. Geological Survey topographic map with the project location, project and permitted biologist's name, specific Quino location, and the estimated number of individuals observed.

8. All colonial webs and butterfly larvae should be photographed using a magnification suitable to identify the species. Adult Quino should also be photographed.

Upon completion of the adult survey, the biologist(s) should provide the appropriate Fish and Wildlife Office with a report within 45 calendar days after completing the last survey at each project site (see Appendix C).

III. ADDITIONAL INFORMATION AND LIMITATIONS

A. Occasionally, circumstances may justify or necessitate deviation from this survey protocol. At our discretion, such deviations will be evaluated on a case-by-case basis. Such deviations may be allowed if: (1) the permitted biologist justifies to us in writing why deviations are required; and (2) the appropriate Fish and Wildlife Office concurs in advance with the deviations in writing.

B. We reserve the right to reject Quino habitat assessments and adult surveys conducted under this survey protocol if: (1) the specific methods described above are not followed, excluding approved deviations; (2) the permitted biologist does not provide us with an adequate written report of the results within 45 calendar days of the last survey; or (3) other information indicates that the survey is inadequate or inaccurate.

IV. U. S. FISH AND WILDLIFE SERVICE CONTACTS

For areas from Santa Cruz County south to Malibu Creek in Los Angeles County, north of the Angeles National Forest, contact the Ventura Fish and Wildlife Office, 2493 Portola Road, Suite B, Ventura, California 93003 (telephone: 805-644-1766; fax: 805-644-3958). For areas from Los Angeles County, including and south of the Angeles National Forest, to San Diego County, contact the Carlsbad Fish and Wildlife Office, 2730 Loker Avenue West, Carlsbad, California 92008 (telephone: 760-431-9440; fax: 760-431-9618)

Please contact the following people at the Carlsbad Fish and Wildlife Office for further information on the Quino: Eric Hein, Susan Wynn, or Douglas Krofta (San Diego County); Michelle Shaughnessy, Jeff Newman, or Douglas Krofta (Riverside, Los Angeles, and San Bernardino Counties), or John Bradley or Douglas Krofta (Orange County). For the Ventura Fish and Wildlife Office, please contact Rick Farris or Colleen Sculley.

APPENDICES

Appendix A

Flowchart

Appendix B

Survey Area Map

A map of potential Quino habitat and Adult Focused Survey Areas was developed for the 1999 field season (Survey Area Map), using the best scientific and commercial data available. The polygon of potential habitat was developed by mapping the: (1) historic and currently known elevational range of Quino, (2) historic and current Quino locations, (3) vegetation communities where Quino have been detected, and (4) areas that contain potential habitat or habitat components. A polygon was drawn around these areas to delimit where focused habitat assessments are recommended to evaluate whether suitable Quino habitat exists. Adult surveys in these areas will be based on the results and recommendations from the focused habitat assessment. Thus, not all areas that conducted focused habitat assessments will conduct adult surveys.

The Survey Area Map also contains Adult Focused Survey Areas. These areas where drawn by plotting Quino observations from the 1997 and 1998 field seasons and buffering each location by a distance of 3 miles (Harrison et al. 1988; Harrison 1989; Murphy pers. comm.). The buffered locations were mapped as three polygons by connecting the perimeters that were inside the potential Quino habitat. Within the Adult Focused Survey Areas, adult surveys should be conducted, unless evidence is provided that indicates suitable Quino habitat is not present.

The Survey Area Map is regional in scope, because the GIS coverages have the potential for imprecisely classifying vegetation communities. Polygons are approximate and should not be interpreted as precise boundaries excluding certain parcels. We recommend that biologists use best professional judgement in determining whether lands fall inside or outside the Potential Habitat Area or within the Adult Focused Survey Areas on the Survey Area Map.

Appendix C

Notification and Reporting: Habitat Assessments

If suitable Quino habitat is not detected during a focused habitat assessment, we still recommend that a report be sent to the appropriate Fish and Wildlife Office. This information may be used to refine the potential habitat area in future survey protocols. The report should include:

1. A map depicting the project boundaries on a 7.5' U.S. Geological Survey topographic quadrangle. The map should contain the project name and the name of the topographic quadrangle. Maps showing the project location with a star, arrow or point are unacceptable.

2. A list of the biologist(s) and associated personnel who will be conducting the assessment.

3. A table indicating the date, time, and weather conditions of the assessment. Acreage surveyed and total acreage of the site should also be included.

4. A detailed description of the vegetation communities and topographic features of the site, including a complete list of plants and animals identified during the assessment. The location of any suitable habitat components should be clearly mapped on a 7.5' U.S. Geological Survey topographic quadrangle.

5. A minimum of four representative color photographs of vegetation communities or the landscape at the site. The report should also include photographs of suitable habitat (e.g., food plants, nectar sources) and any butterfly larvae detected.

Notification and Reporting: Adult Surveys

Because of the potential to incidentally take Quino during surveys by trampling eggs, larvae, pupae, and thermoregulating adults, and harassing or harming individuals while conducting adult surveys, adult surveys must be conducted by a biologist possessing a recovery permit (permitted biologist) pursuant to section 10(a)(1)(A) of the Act. The intent is to ensure that only biologists who have a strong working knowledge of the identification, biology, and ecology of the Quino and sympatric species conduct adult surveys.

Prior to initiating the adult surveys, we recommend that permitted biologists provide the appropriate Fish and Wildlife Office with a pre-survey notification in writing for each project site. We suggest the notification include the following:

1. A map described in number 1 under habitat assessments.

2. A list of permitted biologist(s) who will be conducting the adult surveys. **Note:** All personnel conducting adult surveys should be listed as independent or supervised investigators on a section 10(a)(1)(A) recovery permit prior to surveying.

Generally, reports should have an introduction, project description, regional and specific project maps, vegetation maps, survey methods, survey results, conclusions, and all applicable supportive information including field forms and photographs. Specifically, reports should include the following:

1. A map as described in number 1 under habitat assessments.

2. A table indicating dates, the times surveys were initiated and terminated, the air temperature, weather conditions (e.g., described on the field forms) at the beginning, throughout, and at the end of each survey, results, and names of all permitted biologists conducting each survey.

3. The location of any suitable habitat components (e.g., food plants, nectar sources, and topographic features) should be clearly mapped on a 7.5' U.S. Geological Survey topographic quadrangle.

4. If applicable, a 7.5' U.S. Geological Survey topographic quadrangle with the locations of all Quino larvae and/or adults detected.

5. Detailed lists of plants and animals, including all butterflies, identified or detected on the site during adult surveys, including the scientific and common names.

6. A complete description of the survey methods if the methods deviated from these protocols.

7. High quality photocopies of all original field notes from each survey.

8. Completed field forms for each survey conducted.

9. All applicable, supportive, non-copyrighted photodocumentation. This should include:

    a. A minimum of four representative color photographs of suitable habitat (e.g., food plants and nectar sources) that was surveyed.
    b. Photographs of larvae, colonial webs, and Quino detected during the surveys.

c. Photographs should be labeled with permanent ink or slide label with project name, location of the project site (i.e., city or distance in miles to nearest city), location on the project site, azimuth from which photograph was taken, date photograph was taken, and name of photographer. Photographs should be placed in photographic archive sheets and bound into the report.

10. If Quino are detected[1], a copy of the complete report should be sent to the Natural Diversity Data Base of the California Department of Fish and Game at the following address:

Staff Zoologist
Natural Diversity Data Base-Department of Fish and Game
1220 S Street
Sacramento, California 95814

[1] The Natural Diversity Data Base does not track negative survey results.

Appendix D

Survey and Detection Forms

The attached field forms are provided to assist the appropriate Fish and Wildlife Office in the collection of accurate and valid data for the Quino. This information will assist in delineating the current distribution and habitat associations of locations where Quino have and have not been documented. We believe a standardized form will reduce some of the inherent variability of field data. The survey forms consist of a general habitat form (general form) and an additional Quino detection form (detection form). The general form should be completed by each surveyor for every visit to a site, whereas the detection form should only be completed for every visit when Quino are detected. Therefore, both forms would be completed for a particular visit when Quino are detected. The forms were based upon individual feedback from recognized Quino experts and other entomologists provided at and subsequent to a Quino workshop held at the Carlsbad Fish and Wildlife Office in early December 1998.

These forms do not replace the need for identifying and mapping habitat components, describing the vegetation communities and topographic features, and a providing complete list of plants and animals, including butterflies, identified during the surveys.

Quino Checkerspot General Form Survey type: Habitat Assessment/Adult Survey

Surveyor:_____ Date:_____ Site Visit No: 1 2 3 4 5 6 7 8 9 10

(mm/dd/yyyy)

Total site acres:_____ Site Name:_____ Site Location:_____

Time (24 hr)	Sky	Wind (Beaufort)	Temp F or C
Begin	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	
End	clear/ partcloudy/overcast/fog/drizzle/shower	<1 1-3 4-7 8-12 >12	

Total hours surveyed:_____

Focused Survey Acres:_____ Elev Min: _____ft Max:_____ft

Describe, map, and estimate areas surveyed below.

Host Plants[a]	Patch Size (ft^2)	No Plants/ft^2	Sparse/Dense[b]	Map ID[c]	

a. Larval or nectar resources. Identify species. b. Sparse= plants not touching; dense = plants touching c. Corresponds to polygon on a map.

Surrounding land uses (including adjoining properties):

North _____ Distance _____ ft./mile
South _____ Distance _____ ft./mile
East _____ Distance _____ ft./mile
West _____ Distance _____ ft./mile

Habitat onsite (circle): open soils hilltop ridge Plantago Castilleja soil crusts old roads nectar clay soils rock outcrops

Conditions: (e.g.,grazing agriculture sowbugs/earwigs recent fire grading)
Other: _____

Butterflies Observed (larvae or adults)	**Number**	**Comments**
Pale Swallowtail (*Paplio eurymedon*)		
Anise Swallowtail (*P. zelicaon*)		
West Tiger Swallowtail (*P. rutulus*)		
Sara Orangetip (*Anthocharis sara*)		
Felder's Orangetip (*A. cethura*)		
Cabbage White (*Artogeia rapae*)		
Sleepy Orange (*Eurema nicippe*)		
Common White (*Pontia protodice*)		
California Dogface (*Zerene eurydice*)		
Alfalfa Butterfly (*Colias eurytheme*)		
Harford's Sulfur (*C. harfordi*)		
California Ringlet (*Coenonympha californica*)		
Monarch (*Danaus plexippus*)		
Queen (*D. gilippus*)		
Henne's Checkerspot (*Euphydryas chalcedona hennei*)		
Calcedon Checkerspot (*E. chalcedona chalcedona*)		
Quino Checkerspot (*E. editha quino*)		
Gabb's Checkerspot (*Charidryas gabbii*)		
Leanira Checkerspot (*Thessalia leanira wrighti*)		
Mylitta Cresent (*Phyciodes mylitta*)		
Painted Lady (*Vannessa cardui*)		
West Coast Lady (*V. annabella)*		
Virginia Lady (*V. viginiensis*)		
Red Admiral (*V. atalanta*)		
Buckeye (*Junonia coenia*)		
Mourning Cloak (*Nymphalis antiopa*)		
California Sister (*Adelpha bredowii californica*)		
Satyr Anglewing (*Polygonia satyrus*)		
Lorquin's Admiral (*Basilarchia lorquini*)		
Western Tailed Blue (*Everes amyntula*)		
Southern Blue (*Glaucopsyche lygdamus australis*)		
Echo Blue (*Celastrina ladon echo*)		
Sonoran Blue (*Philotes sonorensis*)		
Marine Blue (*Leptotes marina*)		
Acmon Blue (*Icaricia acmon*)		
Pygmy Blue (*Brephidium exilis*)		
Gray Hairstreak (*Strymon melinus*)		
Brown Elfin (*Incisalia augustinus*)		
Perplexing Hairstreak (*Callophrys perplexa*)		
Grt Purple Hairstreak (*Atlides halesus*)		
Behr's Metalmark (*Apodemia mormo virgulti*)		
Wright's Metalmark (*Calephelis wrightii*)		

Quino Checkerspot Detection Form

Surveyor:_____ Date:_____ (mm/dd/yyyy) Site Visit No: 1 2 3 4 5 6 7 8 9 10

Total acres:_____ Site Name:_____ Site Location:_____

Time detected:_____ (24 hour) Sky Condition: clear Part Cloudy Overcast Fog Drizzle Showers

Wind: <1 1-3 4-7 8-12 >12 (Beaufort)
Temp:_____ F/C

Topo Description:T_____ R_____ 1/4 of_____ 1/4 Sec_____

Elev:_____ft % Slope: >10 11-25 26-50 >50 Aspect: N S E W

Distance to Water:_____ft Water Type:_____ Earwigs yes/no Sowbugs yes/no

Veg Comm/Habitat type:_____
Co-occur butterfly spp:_____
Dominant
Plant Species present:_____
_____

Distance to Plantago:	_____ ft.	No. Plants_____	Patch size _____ ft^2
	_____ ft.	No. Plants_____	Patch size _____ ft^2
Castilleja:	_____ ft.	No. Plants_____	Patch size _____ ft^2
	_____ ft.	No. Plants_____	Patch size _____ ft^2

QCB Behavior: sit nectar mate fly chase Sex: M F Unk Wing Wear: fresh intermed worn

Comments: _____

Nectar spp:_____ Type substrate or soils:_____ Defend area: Y/N

Number of QCB:_____adult/larva Size of occupied area:_____acres ft^2

Habitat w/in 100 ft. of QCB (circle all that apply): open soils hilltop ridge Plantago Castilleja soil crusts old roads nectar clay soils rock outcrops recent fire grading other? _____

Habitat Quality: Poor Fair Good Excellent
(disturbed----------native stand)

Comments? _____
_____
_____

Surrounding land uses:

North	_____	Distance _____ ft.
South	_____	Distance _____ ft.
East	_____	Distance _____ ft.
West	_____	Distance _____ ft.

Appendix E

Natural History Sheet

A. Distribution

The historic range of the Quino extended from the Santa Monica Mountains and Santa Clarita Valley east and south along the foothills of the Transverse and Peninsular ranges in California, and south into northwestern Baja California, Mexico (Appendix B). Extant populations of the butterfly are currently known from southern San Diego County and western Riverside County in California, and northwestern Baja California, Mexico (Mattoni et al. 1997). Adults have been found from Point Dume and Dana Point in Los Angeles and Orange counties, respectively, to approximately 1,500 meters (5,000 feet) in the Anza region of southwestern Riverside County, California (Mattoni et al. 1997, Pratt unpubl. data).

B. Threats

The Quino may have been one of the most abundant butterfly subspecies in coastal southern California until the 1960s. Currently, it is in danger of extinction (USFWS 1997, Mattoni et al. 1997) as a result of habitat loss; displacement of larval food plants and adult nectar sources by non-native vegetation; competition and predation by exotic invertebrates (e.g., earwigs and sowbugs); over-grazing; fire management practices; adverse weather (e.g., drought or floods); over-collection by butterfly hobbyists and researchers; and off-road vehicle activity (USFWS 1997, Mattoni et al. 1997).

C. Life History - 2 Phases

Quino has two distinctive life history phases: early (egg, larva, and pupa) and adult. Each phase has distinct habitat requirements. Adult Quino fly from approximately mid-February to mid-May, depending on weather and elevation. Females lay egg masses containing 20-120 eggs, with an average of approximately 450 eggs produced by an individual. Eggs hatch in 14-18 days and larvae begin to feed immediately on *Plantago erecta*. *Antirrhinum coulterianum, Collinsia concolor*, and *Castilleja exserta* have been shown to support larvae in the laboratory (Pratt, unpubl. data) and *Collinsia* spp. and *Castilleja* spp. are larval food plants for other *Euphydryas editha* subspecies (Singer 1971, 1972, 1982; White 1974; Garth and Tilden, 1986). Therefore, larval food plants may include other members of the Plantaginaceae and Scrophulariaceae plant families. During the third or fourth instar, Quino larvae enter into an obligatory diapause which corresponds with food plant senescence. Diapause may extend for several to many years in response to drought or adverse conditions (G. Pratt, pers. obs.; Mattoni et al. 1997). Quino larvae, similar to Bay checkerspot (*Euphydryas editha bayensis*) and other butterflies, have the ability to undergo diapause for several years or re-enter diapause if food plants are not sufficient to complete growth during a given year (Donahue 1975; Singer and Ehrlich 1979; Powell 1986; Harrison 1989; Allen 1990; White and Levin 1981; Pratt, pers. comm.). In fact, Allen (1990)

and others (Pratt, pers. comm.) suggest that in years of low winter rainfall, Quino larvae may not break diapause for periods of up to 5 or even 7 years. After termination of diapause, coincidental with fall or winter precipitation, larvae feed and then enter their pupal stage or re-enter diapause. The adults emerge in approximately 2 weeks, feed mostly on small annuals (e.g., *Lasthenia* ssp., *Cryptantha* spp., *Gilia* spp., *Salvia columbariae*, and *Lotus* spp.), disperse, reproduce, and die. Additionally, adult nectar plants play a significant role in *Euphydryas editha* egg production and population dynamics (Murphy et al. 1983).

Osborne (1998) found Quino larvae were present within a 60 by 160 meter plot when Daubenmire (1959) plots estimated one *Plantago erecta* plant per square meter. Quino have also been detected in areas where *Plantago* spp. varied from about 6 to 50 plants per square meter (White and Levin 1981). Furthermore, Orsak (1977) suggested that hundreds of *Plantago erecta* plants probably could support a small Quino population. Nevertheless, the localized distribution of *Euphydryas editha* and *Plantago erecta* does not always overlap (e.g., see Johnson et al. 1968). In fact, adult Quino have been found in areas that apparently contain little or no *Plantago erecta*, have thick non-native vegetation (e.g., *Erodium* spp. *Avena* spp.; Hein and Nagano unpubl. data), or in areas where *Plantago erecta* was not observed within several hundred meters of Quino (Pratt, unpubl. data). Murphy (pers. comm.) also suggests that adult Quino may be found up to 100 yards from larval host plants (e.g., *Plantago* spp. and *Castilleja* spp.) and adult males have been documented about 0.8 km (0.5 mi) from good habitat containing abundant larvae and adults (Osborne, pers. comm.). Adult Quino often occur, (and are most easily detected on), open or sparsely vegetated rounded hilltops, ridgelines, and, occasionally, rocky outcrops. Adults have been observed sunning themselves at the bases of hills, and they have been seen flying through areas containing unsuitable habitat, apparently dispersing to sites possessing larval food plants and/or nectar sources.

D. Habitat

Micro and macro topography appear to influence *Euphydryas editha* development and distribution (e.g., Weiss et al. 1988); larvae and adults have been detected on warmer south-facing slopes early in the season, whereas later in the season they were detected on cooler north-facing slopes. Early in the 1900s, large populations of Quino occurred in coastal areas of Orange and San Diego counties in association with meadows on clay soils with little to no non-native vegetation (Osborne pers. comm.). Many Quino populations now appear to be associated with loamy soils with moderate to high amounts of clay, located within sparsely vegetated areas that contain potential host plants and nectar sources, and generally a moderate to high percentage of native plants. However, Quino have also been found along the desert transition on decomposed granite soils (Pratt, pers. comm.). Topographically diverse sites are likely important for the detection and long-term persistence of Quino populations (e.g., Weiss et al. 1988, Pratt, pers. comm.).

Suitable Quino habitat appears to contain low levels of non-native vegetation (e.g., *Bromus* spp. or *Avena* spp.), open or bare soils with a moderate to heavy clay content or with cryptogamic

crusts (i.e., composed of fungi, mosses, and lichens), sparse to moderate distribution of shrubs, presence of larval food plants interspersed with nectar sources, and ridges, rounded hilltops, or other topographic features within approximately 0.8 km (0.5 miles; Osborne pers. comm.). The habitat components have been found in association with, but not restricted to vernal pools, sage scrub, chaparral, native and non-native grassland, and open oak and juniper woodland communities.

Appendix F

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